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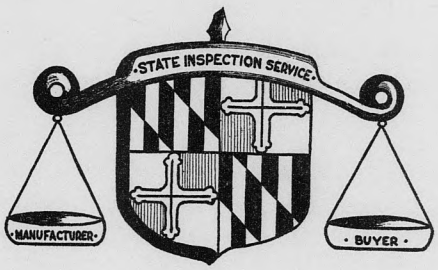
Agricultural Liming Materials

This publication contains the results of chemical and mechanical examinations upon lime samples offered for sale in Maryland from November 1, 1928, to November 1, 1929, together with a brief account of the process by which liming materials reach the Maryland Market.



STATE LIME INSPECTION SERVICE
Controlled by
UNIVERSITY OF MARYLAND
COLLEGE PARK, MD.

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AGRICULTURAL LIMING MATERIALS

November 1, 1928—November 1, 1929

Compiled and edited under the supervision and direction of L. B. Broughton, State Chemist, and L. E. Bopst, Associate.

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INTRODUCTION

The State Lime Inspection Law provides that all liming materials to be offered for sale in Maryland shall be previously registered with the Lime Inspection Service. At the time of registration a record of the brand name of the material, a guaranteed analysis thereof, and the name and address of the manufacturer or other party responsible for its distribution are filed for record. The law further requires that this information, together with a statement of the net weight of the individual package, shall appear on, or attached to each container. It is the duty of the Lime Inspection Service to see that these provisions of the law are observed, to collect and analyze samples of as many of the products offered for sale as possible, and to publish periodical reports of the results of its activities.

This publication renders an account of the work done in the period between November 1, 1928, and November 1, 1929. The 108 official samples examined may be classified roughly as follows:

Hydrated Limes	48
Burnt Limes	32
Ground Limestones, Marls and Oyster Shells	21
Gypsums and Land Plasters	5
Miscellaneous	2

Since the availability and, consequently, the agricultural value of a ground stone or shell depends upon the fineness of grinding as well as upon the actual calcium and magnesium content, our laboratories make mechanical as well as chemical analyses of these products. The results of our mechanical examinations are included on the last pages of this bulletin.

During the past year our laboratories also analyzed for the residents of the State forty-four samples of liming materials. Since these samples were not taken under the supervision of our inspectors, they are not listed among the official samples and the results of these analyses have been reported privately to the senders of the samples. Obviously the lime inspection laboratories are not equipped to offer unlimited service of this kind nor could they do so without trespassing upon the legitimate preserves of commercial laboratories. However, such samples as can be accepted receive the same careful examination as is the invariable rule in our official work.

THE MANUFACTURE AND EFFECTIVENESS OF SOIL-LIMING MATERIALS

Some years ago it occurred to the officials of the State Lime Department that a brief account of the processes by which liming materials reach the Maryland market might prove not only interesting but informative to many of the readers of the lime bulletin. Accordingly, the representatives of the department employed the opportunities open to them in the course of their duties to make a thorough survey of this industry in Maryland. The article prepared (and published in the 1924 number of "Agricultural Liming Materials") was so well received and requests for that bulletin were so numerous that it has long been out of print. In order to meet the demands which still come to us from time to time, we are again presenting this material. The present article is a reprint with only such slight modifications of the original text as seemed necessary to bring it completely up to date. No specific plant or organization is described, but a fairly representative picture of modern methods is outlined.

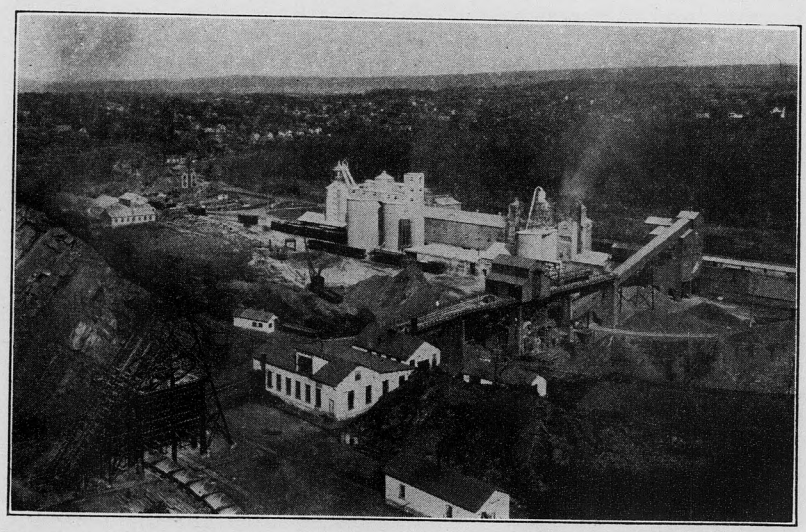

Fig. I—A Modern Lime Plant.—Presented as not descriptive of any one plant but as indicative of the various stages of production.

VARIETIES OF SOIL-LIMING MATERIALS

In Maryland there are five soil-liming materials commonly found on the market. They are quick or caustic lime in ground or lump form, hydrated lime, ground or crushed limestone, ground or crushed oyster shell and marl.

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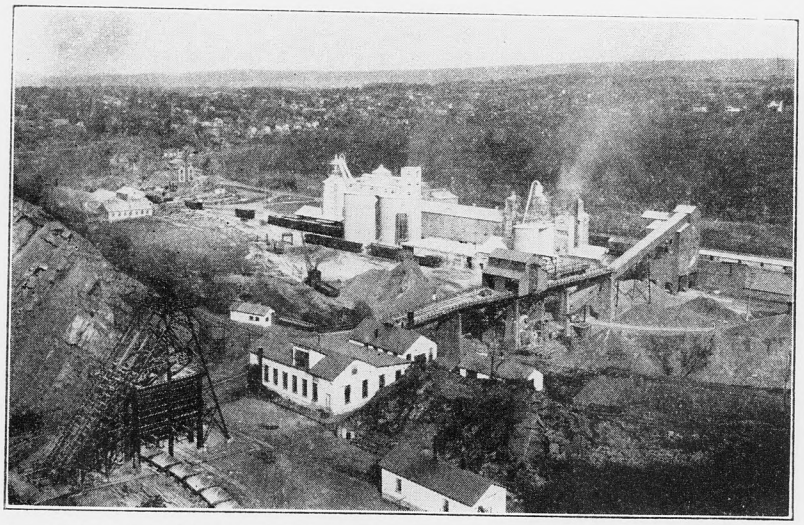

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QUICKLIME

Process of Manufacture

Quicklime is obtained by heating limestone to its dissociation temperature, under which condition the carbon dioxide and other volatile matter are expelled. Quicklime consists primarily of calcium oxide and magnesium oxide, but may contain small amounts of iron oxide and silica, with traces of other impurities, depending upon the purity of the stone from which the lime is made. For agricultural uses, only the calcium oxide and the magnesium oxide are of value. The suitability of lime for agricultural purposes may therefore be controlled by the selection of the stone to be burned and by the thoroughness of the burning.

Locating the Quarry—The quarry must be located where geologic investigations indicate that there is a large supply of limestone very high in calcium carbonate, or in the combined carbonates of calcium and magnesium, and very low in other constituents. It must also conform to certain physical requirements, such as transportation facilities, fuel supply, overburden, and topography.

Stripping—Before opening the quarry the overburden must be removed. Depending upon local conditions, this stripping must be done by hand-digging, plow and shovel, steam shovels or hydraulically.

Quarrying—In quarrying, the first operation is the drilling preparatory to blasting, the drill being operated by compressed air, electricity, steam, or hand. The holes are then charged with powder and the stone blasted. In some cases, shooting before blasting is practiced, which consists of enlarging the drill hole with a miniature blast. Large boulders resulting from the blast are reduced to suitable sizes for the crushers by drilling and blasting or by hand-sledging.

Crushing—After sorting out the unsuitable material, the stone is delivered to the jaw-crushers by cable-cars, belt conveyors, horse-cars, or by gravity. The crushers reduce the largest-sized stones to sizes that can be burned economically and effectively in the kilns, the smaller sizes passing through unchanged. In many quarries the mechanical crushing is entirely replaced by hand-sledging, in which case the "spalls" or "chips" are discarded.

Screening—From the crushers, the lime rock is elevated by conveyor to a rotary or bar screen, where material larger than five inches in diameter passes over the screen and is conveyed to the top of the vertical shaft kilns and dumped into the kiln reservoir. Depending on local conditions, it may be

conveyed by wheelbarrow, horse and cart, cable-car, or belt conveyor. The material smaller than five inches in diameter, which passes through the screen, is disposed of in one of two ways. It may be conveyed to the limestone mill where it is crushed and pulverized with hammer or bar mills and marketed as pulverized limestone or aggregate without further chemical treatment, or it may be screened to two finenesses smaller than five inches, each of which is converted into lime, the finer portion being burned in a rotary kiln and the coarser portion in a specially modified shaft kiln. These kilns are recent modifications of the standard shaft kiln, and are designed to handle the material too fine for the shaft kiln. As yet they have been installed in but few lime plants.

Cooling—The lime as it drops from the kiln is red hot and is cooled by spreading on the floor, by storage in a cooling bin, or, in case a rotary kiln was used for burning, by passing it through a rotary cooler.

Grinding and Packing—After cooling, the lime, which is known as lump quicklime, may be disposed of in a number of ways. It may be barreled for shipment in lump form, it may be shipped in bulk, it may be converted into hydrated form, or it may be pulverized and bagged, either immediately or after an indefinite time in moisture-proof storage bins.

EFFECTIVENESS

Quicklime is a concentrated material. As found on the market, quicklimes carry from 75 to 95 per cent of oxides of lime, or 1,500 to 1,900 pounds per ton, with exceptions at each extreme.

Lump quicklime must be slaked before spreading on the soil. In this process, when employed on the farm, there is some loss in strength on account of incomplete action which leaves some lumps not finely divided. It has been estimated that the discount to offset this loss is about 10 to 15 per cent. In view of this, most lump limes would have an effective strength of 1,400 to 1,700 pounds per ton.

When lump quicklime is ground, the material retains a similar chemical composition, but may be more widely distributed throughout the soil. Unlike the lump lime, the ground quicklime need not be slaked preparatory to spreading on the field, and hence its strength need not be discounted, but will retain an effectiveness of 1,500 to 1,900 pounds of oxides of lime to the ton, depending upon the purity of the stone from which the lime was made and the thoroughness of the manufacturing process. Physically, the ground material resembles coarse meal in appearance; particles of fresh granular quicklimes

take on water and are thus converted into slaked lime, after which the lime constituents function as though applied as slaked or hydrated lime.

HYDRATED LIME

Process of Manufacture

Hydrated lime is quicklime chemically satisfied with water and subjected to an extreme fineness of division. All of the operations to be gone through in the manufacture of quicklime are therefore necessary before hydrated lime can be obtained. The quicklime is converted into the hydroxide and disposed of as hydrated lime. In some plants all of a given batch of quicklime is hydrated, and in other plants only the finer portions, which are removed from the granulated material by air separation.

Hydration—The lump lime to be hydrated is crushed and conveyed mechanically to an apparatus that provides for supplying the lime with the proper amount of water at the proper rate to convert it into an hydroxide of the required chemical and physical properties. Three types of hydrators are in use, differing in principle, but all providing for mechanical mixing and for conserving the heat of the chemical reaction in sufficient degree to hydrate effectively without burning. The hydrate may be discharged in a dry condition and bagged for shipment or it may be submitted to further chemical and mechanical treatment.

Aging—Sometimes it is necessary to age the hydrate to effect complete hydration, in which case the wet material from the hydrator drops into a bin or silo where it is seasoned with moisture and heat for a time sufficient for hydration to be thoroughly completed.

Screening—The material from the hydrator, or from the silo in case the hydrate was aged, passes over a screen where that part which will not hydrate, consisting of carbonate, silicate, and other material in lump form, is removed.

Finishing—The hydrated lime is finished for the market by reducing it to a very fine pulverulent condition. It is done by a combined milling and air-separation process, or by passing it through some standard pulverizing mill, such as a tube mill or a roller mill.

Storage and Bagging—The material is next elevated to bins from which it passes into automatic bagging machines, where it is prepared for shipment in paper or cloth bags.

EFFECTIVENESS

The oxides of lime equivalents in hydrated limes run from 60 to 80 per cent; that is, 1,200 to 1,600 pounds of oxides of lime to the ton. Being a product of burnt lime, this hydrate is quite active in the soil. It may speedily combine with silicate substances in a useful capacity or change into the carbonate form again, in which case it is thoroughly available by virtue of its fine state of division either for the plant or improving the general productivity of the soil.

Physically, hydrated lime is ideal; it is a flour-like powder. The great part of most hydrate is finer than 1/200 of an inch, or will pass a 200-mesh sieve. The active chemical form and the extreme fineness of this material contribute to its fullest efficiency in the soil.

GROUND OR CRUSHED LIMESTONE

Process of Manufacture

As the name implies, this product is made by grinding the raw limestone rock. The sequence of the operations necessary to produce this product are identical with the first steps required in getting the stone ready for the lime kiln, as previously described. In other words, the quarry must be located, the overburden must be stripped, the quarrying (drilling and blasting) must be done, the stone must be crushed, screened into sizes suitable for the mill, then ground until it is in a pulverized condition, fine enough to be bagged and placed on the market.

EFFECTIVENESS

The oxides of lime equivalents in this material range from 45 to 55 per cent, depending upon the purity of the original stone, or from 900 to 1,100 pounds of oxides to the ton. The total number of pounds of oxides in a ton of ground limestone, as commonly found on the market in this State, however, does not conform to the total number of pounds of available or effective oxides in the material, but must be discounted according to the mechanical analysis. The amount of such discount has been the basis of a good many investigations in various states. Different findings on this point have been reported by various investigators, and the concensus of opinion seems to indicate that it is only that portion of the material which will pass through an 80-mesh sieve that is immediately available to soils and crops, although it is found that practically all of the material passing through a 60-mesh sieve is theoretically available in the course of years. A very satisfactory method that has been advanced for discounting the effectiveness of ground

limestone is to ascribe, over a five-year period, full availability to that which passes a 60-mesh sieve, one-half availability to that which is caught on the 60-mesh sieve but passes a 20-mesh sieve, and to consider as practically inactive that material which is caught on a 20-mesh sieve. When figured on this scale and taking into consideration the actual oxide of lime content, the effective oxides of lime in the average ton of limestone found on the Maryland market will range from 800 to 1,050 pounds.

The effectiveness, then, of ground limestone is governed almost entirely by the fineness of grinding, and for this reason the mechanical analysis is primarily the limiting factor. Particular attention is therefore paid to this factor as a measure of protective service, as we pick up samples of limestone with a wide range of variance in mechanical analyses; in some of these samples over half of the material will readily pass through an 80-mesh sieve, indicating an excellent availability, and in other samples we have found that 20 per cent is caught on a 20-mesh sieve, indicating a dilute material, which must be applied in excessive quantity in order to place any appreciable amount of its effective portion in the soil.

GROUND OR CRUSHED OYSTER SHELLS

Process of Manufacture

As is the case in the producing of agricultural limestone, the manufacture of pulverized oyster shells for soil-liming is comparatively a simple process. The industry, of course, has its geographical limitation, inasmuch as a continuous supply of shells must be assured before justification can be had for the installation of grinding, bagging and shipping apparatus.

More than one type of mill is in use for grinding this material, but the sole object is always to pulverize, and no description need be given of any particular crusher or grinder.

Realizing the economy of being able to place a concentrated form of soil-liming material on the market, attempts have been made by several concerns in Maryland to bake or burn the shells on a commercial scale, so as to dissociate them sufficiently to drive off, at least partially, the carbon dioxide. The samples we have obtained of the material, however, have shown only slightly higher oxide content than in the ordinary ground raw shells, indicating that the method used is for some reason ineffective, except as a material aid in the grinding of the sample.

EFFECTIVENESS

The oxides of lime equivalents in oyster shells will range from 35 to 50 per cent, depending upon the amount of sand and insoluble matter present. This means 700 to 1,000 pounds of oxides to the ton. Here, again, distinction must be made between the total oxides and the effective oxides, as the total must be discounted in proportion to the fineness of material. The formula that has been recommended for the calculation of available oxides in ground limestone is also applicable to oyster shells, which will show an effective oxide of lime content of somewhere between 500 and 800 pounds to the ton, with some exceptions at one extreme and some exceptions at the other. Attention is therefore directed to the mechanical analyses of the material rather than the chemical analyses, as shells are fairly constant in their composition, but may and do vary widely in degree of fineness when ground and placed on the market as a soil-liming material. When material, ground fine enough to pass a 100-mesh sieve, is applied at the rate of 2,000 pounds per acre, it will have a theoretical possible distribution in the soil of about 1,100 particles to the cubic inch, whereas material that is just fine enough to pass a 20-mesh sieve will have, when applied at the same rate, a possible distribution of less than 20 particles to the cubic inch.

MARL

As described here, marl is the precipitated carbonate as found in Western Maryland and adjacent states.

Process of Manufacture

Thus far no methods have been generally adopted for driving off the carbon dioxide from marl, in order to place it upon the market in a more concentrated form. The main object of the producers of this material has been not to heat the marl to its dissociation temperature but to heat sufficiently so that it will dry out enough to be ground and run through a lime spreader. The methods employed have been in some instances fairly efficient.

Some marl handlers allow their products to air-dry under cover for several weeks; thereby considerably reducing the moisture content, and next to transfer it to cribs under which there is a heated pipe; in this manner a further reduction in moisture is made.

Rotary driers, somewhat similar to those found in lime kilns, have also been used by marl handlers as a means of eliminating excess moisture. Still another process has been

to load the marl on a steel car and to run this car over a heating device, and allow it to stand until moisture in the material has been somewhat reduced.

While the above are not all the methods employed by various marl handlers they tend to give the reader a general idea of the process employed.

EFFECTIVENESS

The total oxides of lime in marl will run from 45 to 55 per cent, or 900 to 1,100 pounds to the ton. If properly dried, marl readily disintegrates and becomes available for the neutralization of soil acidity.

TABLES

The following pages contain a detailed report of the results obtained in the regulation of the sale of limes in this State from November 1, 1928, to November 1, 1929. Limes are considered deficient with respect to chemical analysis when they are one per cent or more deficient in total oxides.

ANALYSES OF AGRICULTURAL BURNT LIME (OXIDES)

No.	Name of Manufacturer	Name of Lime	Place of Sampling	Calcium Oxide CaO		Magnesium Oxide MgO		Sand & Insol. (no Val.)	Total Oxides CaO+MgO
				Found	Guaranteed	Found	Guaranteed	Found	
2213	American Lime & Stone Co., Bellefonte, Pa.	Lump Lime	Cordova	**97.50**	90.00	**.63**	.75	**.03**	**98.13**
2256	J. E. Baker Co., York, Pa.	Victor Burned Lime	York, Pa.	**94.86**	85.00	**3.69**	3.00	**.02**	**98.55**
2164	S. W. Barrick & Sons, Woodsboro, Md.	Agric. Lump Lime	Woodsboro	**87.69**	85.00	**5.00**	5.00	**.70**	**92.69**
2136	S. W. Barrick & Sons, Woodsboro, Md.	Agric. Lump Lime	Woodsboro	**94.98**	85.00	**1.12**	5.00	**.60**	**96.10**
2153	S. W. Barrick & Sons, Woodsboro, Md.	Pulverized Quick Lime	Woodsboro	**75.82**	65.00	**4.27**	5.00	**10.18**	**80.09**
2137	S. W. Barrick & Sons, Woodsboro, Md.	Pulverized Quick Lime	Woodsboro	**75.71**	65.00	**5.43**	5.00	**5.32**	**81.14**
2216	Bear Creek Lime Kiln, Friendsville, Md.	Granulated Lime	Friendsville	**71.39**	70.00	**2.07**	2.00	**7.72**	**73.46**
2220	Cavetown Planing Mill Co., Cavetown, Md.	Lump Lime	Cavetown	**71.23**	80.00	**22.51**	2.00	**.68**	**93.74**
2249	Cavetown Planing Mill Co., Cavetown, Md.	Lump Lime	Cavetown	**75.26**	80.00	**18.76**	2.00	**1.20**	**94.02**
2221	Cavetown Planing Mill Co., Cavetown, Md.	Ground Burned Lime	Cavetown	**64.96**	80.00	**17.38**	2.00	**4.60**	**82.34**
2250	Cavetown Planing Mill Co., Cavetown, Md.	Ground Burned Lime	Cavetown	**68.04**	80.00	**16.29**	2.00	**5.04**	**84.33**
2131	M. J. Grove Lime Co., Lime Kiln, Md.	Famous Frederick County Agric. Lime	Frederick	**88.25**	65.00	**3.76**	5.00	**2.08**	**92.01**
2163	M. J. Grove Lime Co., Lime Kiln, Md.	Famous Frederick County Agric. Lime	Lime Kiln	**89.04**	65.00	**6.51**	5.00	**.26**	**95.55**
2155	M. J. Grove Lime Co., Lime Kiln, Md.	Famous Frederick County Ground Lime	Frederick	**74.70**	65.00	**7.31**	5.00	**5.10**	**82.01**
2132	M. J. Grove Lime Co., Lime Kiln, Md.	Famous Frederick County Ground Lime	Frederick	**66.08**	65.00	**7.45**	5.00	**7.70**	**73.53**
2264	John S. Hyde, Westminster, Md.	Agricultural Lump Lime	Westminster	**89.82**	85.00	**4.42**	5.00	**3.28**	**94.24**
2168	LeGore Lime Co., LeGore, Md.	LeGore Lump Lime	LeGore	**91.84**	80.00	**.63**	3.00	**.83**	**92.47**
2224	Henry Mosser, Oakland, Md.	Burnt Lime	Oakland	**69.66**	68.00	**.72**	.50	**9.32**	**70.38**
2223	Marshall Porter, Eckhart, Md.	Lump Lime	Cresaptown	**81.09**	70.00	**7.28**	13.00	**1.64**	**88.37**
2199	Robert A. Reichard, Inc., Allentown, Pa.	Lehigh Ground Burnt Lime	Preston	**72.24**	45.50	**20.94**	29.50	**3.20**	**93.18**
2172	Shank & Etzler Lime Co., Frederick, Md.	Agricultural Lump Lime	Frederick	**59.81**	60.00	**33.16**	30.00	**1.20**	**92.97**
2133	Shank & Etzler Lime Co., Frederick, Md.	Agricultural Lump Lime	Frederick	**60.26**	60.00	**36.60**	30.00	**.16**	**96.86**
2158	Shank & Etzler Lime Co., Frederick, Md.	Ground Burned Lime	Frederick	**55.06**	55.00	**25.62**	25.00	**9.10**	**80.68**
2159	H. M. Spahr Lime & Stone Co., Spahr, Md.	Spahr's Calimag Lump Lime	Spahr	**57.68**	60.00	**32.72**	30.00	**.72**	**90.40**
2130	H. M. Spahr Lime & Stone Co., Spahr, Md.	Spahr's Calimag Lump Lime	Spahr	**57.57**	60.00	**36.13**	30.00	**.68**	**93.70**
*2160	H. M. Spahr Lime & Stone Co., Spahr, Md.	Spahr's Calimag Gr. Lime	Spahr						

2130	H. M. Spahr Lime & Stone Co., Spahr, Md.	Spahr's Calimag Lump Lime	Spahr	**57.57**	60.00	**36.13**	30.00	**.68**	**93.70**
*2160	H. M. Spahr Lime & Stone Co., Spahr, Md.	Spahr's Calimag Gr. Lime	Spahr	**49.71**	60.00	**29.07**	30.00	**3.80**	**78.78**
*2253	Stoner & Powell, Fountain Rock, Md.	Old Reliable Fountain Rock Lump Lime	Fountain Rock	**67.55**	85.00	**9.99**	2.00	**5.00**	**77.54**
2177	Stoner & Powell, Fountain Rock, Md.	Old Reliable Fountain Rock Lump Lime	Fountain Rock	**91.31**	85.00	**1.59**	2.00	**.58**	**92.90**
2140	Stoner & Powell, Fountain Rock, Md.	Old Reliable Fountain Rock Lump Lime	Fountain Rock	**91.31**	85.00	**1.81**	2.00	**2.20**	**93.12**
*2162	Stoner & Powell, Fountain Rock, Md.	Old Reliable Fountain Rock Ground Lime	Fountain Rock	**66.63**	85.00	**8.47**	2.00	**7.12**	**75.10**
*2141	Stoner & Powell, Fountain Rock, Md.	Old Reliable Fountain Rock Ground Lime	Fountain Rock	**67.98**	85.00	**6.76**	2.00	**7.44**	**74.74**

ANALYSES OF AGRICULTURAL HYDRATED LIME

2214	American Lime & Stone Co., Bellefonte, Pa.	Bald Eagle Hydrated Lime	Cordova	**72.48**	69.00	**1.02**	1.00	**.28**	**73.50**
2255	J. E. Baker Co., York, Pa.	Susquehanna Hyd. Lime	York, Pa.	**66.64**	65.00	**6.37**	3.00	**.52**	**73.01**
2246	J. E. Baker Co., York, Pa.	Susquehanna Hyd. Lime	Centerville	**63.17**	65.00	**11.01**	3.00	**1.30**	**74.18**
2254	J. E. Baker Co., York, Pa.	Victor Hydrated Lime	York, Pa.	**57.68**	55.00	**15.20**	15.00	**.52**	**72.88**
2247	J. E. Baker Co., York, Pa.	Victor Hydrated Lime	Centerville	**61.60**	55.00	**12.07**	15.00	**.56**	**73.67**
2165	S. W. Barrick & Sons, Woodsboro, Md.	Hydrated Lime	Woodsboro	**60.48**	60.00	**4.71**	5.00	**8.77**	**65.19**
2138	S. W. Barrick & Sons, Woodsboro, Md.	Hydrated Lime	Woodsboro	**64.96**	60.00	**3.84**	5.00	**3.80**	**68.80**
2188	Blair Limestone Co., Martinsburg, W. Va.	Blair Spec. Hydrated Lime	Rockville	**64.29**	60.00	**2.97**	1.00	**4.20**	**67.26**
2183	Blair Limestone Co., Martinsburg, W. Va.	Blair Spec. Hydrated Lime	Bel Air	**67.20**	60.00	**3.04**	1.00	**5.06**	**70.24**
2154	Blair Limestone Co., Martinsburg, W. Va.	Blair Spec. Hydrated Lime	Brunswick	**64.96**	60.00	**3.05**	1.00	**6.72**	**68.01**
2126	Blair Limestone Co., Martinsburg, W. Va.	Blair Spec. Hydrated Lime	Rockville	**59.92**	60.00	**5.57**	1.00	**4.70**	**65.49**
2182	Blair Limestone Co., Martinsburg, W. Va.	Opequon Hydrated Lime	Bel Air	**68.54**	65.00	**2.47**	1.50	**3.02**	**71.01**
2166	Blair Limestone Co., Martinsburg, W. Va.	Opequon Hydrated Lime	Brunswick	**65.63**	65.00	**3.26**	1.50	**4.62**	**68.89**
2261	Blair Limestone Co., Martinsburg, W. Va.	Golden Harvest Hyd. Lime	Salisbury	**67.20**	60.00	**3.76**	1.00	**3.56**	**70.96**
2245	Blair Limestone Co., Martinsburg, W. Va.	Golden Harvest Hyd. Lime	Rockville	**66.64**	60.00	**1.68**	1.00	**4.20**	**68.32**
2167	Central Chemical Co., Hagerstown, Md.	Gro-All Hydrated Lime	Hancock	**71.68**	70.00	**.65**	2.00	**.20**	**72.33**
2222	M. J. Grove Lime Co., Lime Kiln, Md.	Famous Frederick County Hydrated Lime	Brunswick	**65.07**	65.00	**5.00**	5.00	**5.24**	**70.07**
2156	M. J. Grove Lime Co., Lime Kiln, Md.	Famous Frederick County Hydrated Lime	Frederick	**64.84**	65.00	**6.52**	5.00	**4.00**	**71.36**
2128	M. J. Grove Lime Co., Lime Kiln, Md.	Famous Frederick County Hydrated Lime	Frederick	**62.94**	65.00	**6.15**	5.00	**4.60**	**69.09**
2157	O. J. Keller Lime Co., Frederick, Md.	Keller Agric. Hydrate	Buckeystown	**65.07**	70.00	**6.36**	2.00	**4.10**	**71.43**
2251	O. J. Keller Lime Co., Frederick, Md.	Keller Agric. Hydrate	Buckeystown	**64.30**	70.00	**6.88**	2.00	**8.10**	**71.18**
2171	LeGore Lime Co., LeGore, Md.	LeGore Hydrated Lime	Westminster	**60.26**	60.00	**5.28**	5.00	**6.07**	**65.54**
2170	LeGore Lime Co., LeGore, Md.	LeGore Hydrated Lime	LeGore	**62.28**	60.00	**4.85**	5.00	**3.64**	**67.13**
2139	LeGore Lime Co., LeGore, Md.	LeGore Hydrated Lime	LeGore	**61.60**	60.00	**4.05**	5.00	**6.30**	**65.65**

* Indicates product deficient in total oxides.

ANALYSES OF AGRICULTURAL HYDRATED LIME

No.	Name of Manufacturer	Name of Lime	Place of Sampling	Calcium Oxide CaO		Magnesium Oxide MgO		Sand & Insol. (no Val.)	Total Oxides CaO+MgO
				Found	Guaranteed	Found	Guaranteed	Found	
2225	North American Cement Corp., Hagerstown, Md.	Berkeley Hydrated Lime...	Maugansville ..	**72.12**	70.00	**1.24**	2.00	**.10**	**73.36**
2206	North American Cement Corp., Hagerstown, Md.	Berkeley Hydrated Lime...	Clinton.....	**72.00**	70.00	**1.38**	2.00	**.08**	**73.38**
2189	North American Cement Corp., Hagerstown, Md.	Berkeley Hydrated Lime...	Rockville.....	**72.80**	70.00	**2.17**	2.00	**.30**	**74.97**
2207	Shank & Etzler Lime Co., Frederick, Md....	Hydrated Lime.....	Waldorf.....	**45.80**	45.00	**22.31**	20.00	**8.00**	**68.11**
2173	Shank & Etzler Lime Co., Frederick, Md. ...	Hydrated Lime.....	Frederick.....	**44.91**	45.00	**22.94**	20.00	**7.92**	**67.85**
2127	Shank & Etzler Lime Co., Frederick, Md....	Hydrated Lime.....	Frederick.....	**45.35**	45.00	**24.87**	20.00	**4.92**	**70.22**
2161	H. M. Spahr Lime & Stone Co., Spahr, Md..	Spahr's Calimag Hydrated .	Spahr.....	**53.96**	50.00	**23.46**	20.00	**3.60**	**77.42**
2152	H. M. Spahr Lime & Stone Co., Spahr, Md..	Spahr's Calimag Hydrated .	Jessup.....	**51.13**	50.00	**20.53**	20.00	**5.92**	**71.66**
2129	H. M. Spahr Lime & Stone Co., Spahr, Md.	Spahr's Calimag Hydrated .	Spahr.....	**44.41**	50.00	**28.30**	20.00	**4.10**	**72.71**
2227	Steacy & Wilton Co., Wrightsville, Pa.....	Sterling Brand Hyd. Lime..	Taneytown....	**70.22**	67.00	**2.89**	5.00	**1.20**	**73.11**
2185	Steacy & Wilton Co., Wrightsville, Pa.....	Sterling Brand Hyd. Lime..	Parkton.....	**70.92**	67.00	**3.47**	5.00	**.40**	**74.39**
2184	Steacy & Wilton Co., Wrightsville, Pa.....	Sterling Brand Hyd. Lime..	Rising Sun....	**72.24**	67.00	**2.83**	5.00	**.36**	**75.07**
2175	Steacy & Wilton Co., Wrightsville, Pa.....	Sterling Brand Hyd. Lime..	Taneytown....	**70.78**	67.00	**3.49**	5.00	**1.92**	**74.27**
2176	Steacy & Wilton Co., Wrightsville, Pa.....	Sterling Brand Hyd. Lime..	Westminster...	**70.90**	67.00	**3.69**	5.00	**1.44**	**74.59**
2178	Stoner & Powell, Fountain Rock, Md.....	Old Reliable Fountain Rock Hydrated Lime....	Woodsboro....	**59.14**	60.00	**6.08**	2.00	**5.84**	**65.22**
2142	Stoner & Powell, Fountain Rock, Md.....	Old Reliable Fountain Rock Hydrated Lime ...	Fountain Rock	**59.32**	60.00	**3.98**	2.00	**6.24**	**63.30**
2208	Superior Lime Co., York, Pa.....	Superior Brand Hyd. Lime	Baltimore.....	**63.18**	65.00	**9.66**	5.00	**.28**	**72.84**
2186	Universal Gypsum & Lime Co., Chicago, Ill.	Palmer Hydrated Lime	Rising Sun....	**71.37**	65.00	**2.39**	5.00	**.26**	**73.76**
2179	Universal Gypsum & Lime Co., Chicago, Ill.	Palmer Hydrated Lime	Emmitsburg...	**70.74**	68.00	**4.27**	2.50	**.40**	**75.01**
2262	Warner Company, Philadelphia, Pa.....	Knickerbocker Hyd. Lime..	Salisbury.....	**45.56**	45.00	**30.63**	30.00	**.88**	**76.19**
2196	Warner Company, Philadelphia, Pa.....	Knickerbocker Hyd. Lime..	Preston.....	**46.36**	45.00	**31.42**	30.00	**.56**	**77.78**
2197	Warner Company, Philadelphia, Pa.....	Warner's "Limoid".....	Preston.....	**49.95**	45.00	**29.68**	30.00	**1.04**	**79.63**
2187	Warner Company, Philadelphia, Pa.....	Warner's "Limoid".....	Elkton.....	**46.28**	45.00	**30.87**	30.00	**1.48**	**77.15**
2180	Washington Building Lime Co., Balto., Md.	Standard Hydrated Lime...	Annapolis.....	**73.47**	70.00	**1.01**	2.00	**.12**	**74.48**
2135	Washington Building Lime Co., Balto., Md.	Standard Hydrated Lime...	Baltimore.....	**74.00**	70.00	**.58**	2.00	**2.48**	**74.58**

ANALYSES OF AGRICULTURAL LIMESTONE, MARL, AND OYSTER SHELLS

ANALYSES OF AGRICULTURAL LIMESTONE, MARL, AND OYSTER SHELLS

2258	Alba Marl Lime Co., Charles Town, W. Va.	Alba Marl	Brunswick	53.42	50.00	.47	.50	2.64	53.89
2259	American Lime & Stone Co., Bellefonte, Pa.	†Alsco Pulverized Limestone	Centerville	53.76	53.79	.53	.48	2.12	54.29
2257	J. E. Baker Co., York, Pa.	†Snow Flake Gr. Limestone	York, Pa.	52.76	48.00	3.11	1.00	.52	55.87
2248	J. E. Baker Co., York, Pa.	†Snow Flake Gr. Limestone	Centerville	52.31	48.00	3.54	1.00	.24	55.85
2134	Beaver Dam Marble Co., Baltimore, Md.	†Dolomitic Limestone	Cockeysville	30.57	30.00	15.40	21.00	13.86	45.97
2265	Beaver Dam Marble Co., Baltimore, Md.	†Dolomitic Limestone	Cockeysville	31.08	30.00	19.80	21.00	6.64	50.88
2244	Herbert Bryant's Son, Alexandria, Va.	†Pulv. Oyster Shell Lime	Gaithersburg	47.26	45.00	.48	.....	10.80	47.74
2149	Central Chemical Co., Hagerstown, Md.	†Gro-All Oyster Shell Lime	Baltimore	46.48	39.20	.58	.50	10.18	47.06
2192	Dorchester Shell & Lime Co., Cambr'ge, Md.	†Oyster Shell Lime	Cambridge	46.03	40.00	.58	.60	12.92	46.61
*2218	East Coast Trading Co., Baltimore, Md.	†E-C Oyster Shell Lime	Baltimore	41.89	47.00	.58	.50	18.08	42.47
*2210	East Coast Trading Co., Baltimore, Md.	†E-C Oyster Shell Lime	Baltimore	45.24	47.00	.61	.50	14.15	45.85
2125	M. J. Grove Lime Co., Lime Kiln, Md.	†Pulverized Limestone	Frederick	51.18	50.00	3.98	.....	2.72	55.16
2191	Natural Lime Marl Co., Roanoke, Va.	Lime Marl	Washington Gr.	53.42	50.00	.57	.50	2.38	53.99
2181	Natural Lime Marl Co., Roanoke, Va.	Lime Marl	Laurel	53.20	50.00	.61	.50	2.40	53.81
2194	Potomac Poultry Food Co., Inc., Balto., Md.	†Potolime Oyster Shell Lime	Crisfield	48.16	46.00	.54	.50	9.92	48.70
2145	Potomac Poultry Food Co., Inc., Balto., Md.	†Potolime Oyster Shell Lime	Hyattsville	45.92	46.00	.61	.50	13.32	46.53
*2252	I. G. Robinson, Hancock, Md.	†Ground Limestone	Hancock	42.33	48.00	3.04	.50	18.95	45.37
*2226	I. G. Robinson, Hancock, Md.	†Ground Limestone	Hancock	44.08	48.00	1.88	.50	16.36	45.96
2243	Standard Lime & Stone Co., Baltimore, Md.	†Standard Pulv. Limestone	Annapolis	54.00	53.20	.53	.50	2.64	54.53
2174	Standard Lime & Stone Co., Baltimore, Md.	†Standard Pulv. Limestone	Brunswick	54.88	53.20	.43	.50	1.84	55.31
2263	Steacy & Wilton Co., Wrightsville, Pa.	†Pulverized Limestone	Taneytown	48.38	50.00	3.76	2.00	3.80	52.14
2195	W. H. Valliant & Bro., Bellevue, Md.	†Baked and Ground Oyster Shell Lime	Bellevue	49.61	42.00	.55	.....	11.04	50.16

ANALYSES OF GYPSUM OR LAND PLASTER

No.	Name of Manufacturer	Name of Lime	Place of Sampling	Calcium Sulphate		Sand & Insol. (no value)
				Found	Guar.	Found
2147	American Agricultural Chemical Co., New York, N. Y.	Fine Ground Nova Scotia Land Plaster	Upper Marlboro	80.80	77.70	3.50
2123	American Agricultural Chemical Co., New York, N. Y.	Fine Ground Nova Scotia Land Plaster	Baltimore	76.40	77.70	1.70
2124	Armour Fertilizer Works, Baltimore, Md.	Land Plaster	Baltimore	73.00	74.00	7.90
2190	Piedmont Mt. Airy Guano Co., Balto., Md.	Land Plaster	Mt. Airy	82.99	77.70	.80
2209	United States Gypsum Co., Chicago, Ill.	Ben Franklin Agric. Gypsum	Baltimore	64.44	64.50	7.30

* Indicates product deficient in total oxides.

† Ground shell or stone, Mechanical Analyses on page 11.

ANALYSES OF MISCELLANEOUS PRODUCTS

No.	Name of Manufacturer	Name of Lime	Place of Sampling	Calcium Oxide CaO		Magnesium Oxide MgO		Sand & Insol. (no Val.)	Total Oxides CaO+MgO
				Found	Guaranteed	Found	Guaranteed	Found	
2169	LeGore Lime Co., LeGore, Md.	Legore All-in-One Agric. Lime	LeGore	**50.40**	45.00	**3.84**	5.00	**9.90**	**54.24**
2200	North American Cement Corp., Hagerstown, Md.	Berkeley Hydra-Calcite Lime	Ellicott City	**67.42**	60.00	**2.60**	2.00	**1.00**	**70.02**

TABLE II—SHOWING MECHANICAL ANALYSIS OF GROUND LIMESTONE AND GROUND OYSTER SHELLS.

For the Chemical Analyses of these samples, see preceding table. Figures are percentages or pounds per hundred. "Mesh" indicates the sieve used; "20 Mesh" has 20 wires to the inch.

No.	Name of Manufacturer	Name of Lime or Kind	Finer than 100 Mesh	Between 80 & 100 Mesh	Between 60 & 80 Mesh	Between 40 & 60 Mesh	Between 20 & 40 Mesh	Coarser than 20 Mesh
2259	American Lime & Stone Co., Bellefonte, Pa.	Alsco Pulverized Limestone	93	4	1	2	0	0
2257	J. E. Baker Co., York, Pa.	Snow Flake Ground Limestone	99	1	0	0	0	0
2248	J. E. Baker Co., York, Pa.	Snow Flake Ground Limestone	99	1	0	0	0	0
2134	Beaver Dam Marble Co., Baltimore, Md.	Dolomitic Limestone	35	8	4	29	24	0
2265	Beaver Dam Marble Co., Baltimore, Md.	Dolomitic Limestone	59	5	4	14	18	0
2244	Herbert Bryant's Son, Alexandria, Va.	Pulverized Oyster Shell Lime	37	7	2	9	28	17
2149	Central Chemical Co., Hagerstown, Md.	Gro-All Oyster Shell Lime	46	6	2	11	32	3
2192	Dorchester Shell & Lime Co., Cambridge, Md.	Oyster Shell Lime	40	13	4	15	27	1
2218	East Coast Trading Co., Baltimore, Md.	E-C Oyster Shell Lime	54	5	2	10	23	6
2210	East Coast Trading Co., Baltimore, Md.	E-C Oyster Shell Lime	39	12	2	13	27	7
2125	M. J. Grove Lime Co., Lime Kiln, Md.	Pulverized Limestone	88	7	1	3	1	0
2194	Potomac Poultry Food Co., Inc., Baltimore, Md.	Potolime Oyster Shell Lime	45	7	2	11	30	5
2145	Potomac Poultry Food Co., Inc., Baltimore, Md.	Potolime Oyster Shell Lime	48	4	4	14	29	1
2252	I. G. Robinson, Hancock, Md.	Ground Limestone	31	5	1	13	30	20
2226	I. G. Robinson, Hancock, Md.	Ground Limestone	35	5	2	7	28	23
2243	Standard Lime & Stone Co., Baltimore, Md.	Standard Pulv. Limestone	91	7	1	1	0	0
2174	Standard Lime & Stone Co., Baltimore, Md.	Standard Pulv. Limestone	96	4	0	0	0	0
2263	Steacy & Wilton Co., Wrightsville, Pa.	Pulverized Limestone	70	6	3	11	10	0
2195	W. H. Valliant & Bro., Bellevue, Md.	Baked and Ground Oyster Shell Lime	40	5	1	10	33	11

The following firms had products registered as outlined, samples of which were not secured by our inspectors in the regular discharge of their duties:

J. E. Baker Company, York, Pa.
Agricultural Lime ---------- CaO 45.5% MgO 29.5 %

Blair Limestone Company, Martinsburg, W. Va.
Shenandoah Ground Burnt Lime------ CaO 48 % MgO 32 %

Falling Spring Lime Company, Inc., Covington, Va.
Falling Spring Precipitated Lime------ CaO 50.4% MgO .24%

M. J. Grove Lime Company, Lime Kiln, Md.
Carbo Oxide ---------- CaO 45 % MgO .50%

LeGore Lime Company, LeGore, Md.
LeGore Ground Burnt Lime---------- CaO 75 % MgO 5 %

North American Cement Corporation, Hagerstown, Md.
Berkley Ground Lime---------- CaO 83 % MgO 2 %
Berkley Pulverized Limestone--------- CaO 44 %

G. Ober & Sons Company, Baltimore, Md.
Nova Scotia Land Plaster---------- CaO 32 %

Patuxent Guano Company, Baltimore, Md.
Patuxent Crushed Oyster Shell Lime-- CaO 46 % MgO .50%

F. S. Royster Guano Company, Baltimore, Md.
Nova Scotia Land Plaster---------- CaO 32 %

Steacy & Wilton Company, Wrightsville, Pa.
Run of Kiln Lump Agricultural Lime-- CaO 80 %

Terra Alta Lime Company, Terra Alta, W. Va.
Alta Brand ---------- CaO 75 %

Universal Gypsum & Lime Company, Chicago, Ill.
Challenge Brand Limestone Flour---- CaO 48 % MgO 6 %
Agricultural Lime in Bulk---------- CaO 88 % MgO 6 %

Warner Company, Philadelphia, Pa.
Warners "Limoid" Inoculated-------- CaO 45 % MgO 30 %
Run-of-Kiln Lime ---------- CaO 56 % MgO 37 %
Pulverized Burned Lime---------- CaO 54 % MgO 36 %
Merion Hydrated Lime ---------- CaO 44 % MgO 30 %
Knickerbocker Run-of-Kiln Lime------ CaO 50 % MgO 33 %
Knickerbocker Pulverized Limestone-- CaO 29 % MgO 19 %
Pulverized Limestone ---------- CaO 29 % MgO 19 %

The Washington Building Lime Company, Baltimore, Md.
Ground Lime in bags ---------- CaO 90 % MgO 2 %
Washington Lime in bulk---------- CaO 90 % MgO 2 %

York Valley Lime & Stone Company, York, Pa.
York Valley Hydrated Lime---------- CaO 68 % MgO 2 %